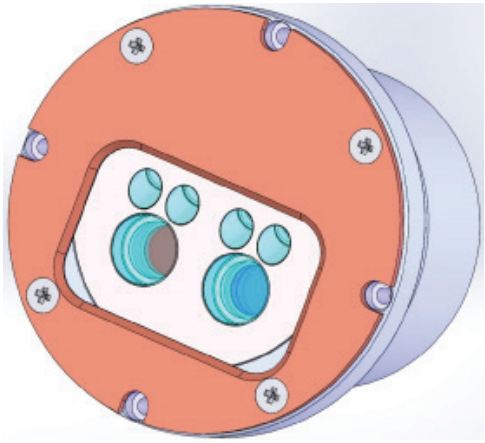
SEA-BIRD SCIENTIFIC

WET Labs

USER'S MANUAL

SeaOWL™ UV-A SLC

- Document Ver: 11/2015, Edition A



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Section 1 Specifications

1.1 Mechanical

Diameter	7.57 cm
Length	5.46 cm
Depth rating	1000 m
Temperature range	-2–38 °C
Storage temperature range	-20–50 °C
Weight in air	0.399 kg
Displacement	128 ml

1.2 Electrical

Input	7–15 VDC
Current draw	81 mA
Linearity	99%

1.3 Communications

Sample rate	1 Hz
RS232 output rate	19200 baud
Output resolution	14 bit

1.4 Optical

Parameter	Wavelength EX/EM	Range, Sensitivity
Chlorophyll (Chl)	470/695 nm	0.005–250, 0.005 µg/L
Fluorescent Dissolved Organic Matter (FDOM)	370/460 nm	0.03–900, 0.03 ppb QSDE
Backscattering	700 nm	0–0.04 m^{-1} sr^{-1}, 1E-06 m^{-1} sr^{-1}

Crude oil limit of detection, sensitivity	< 80, 3 ppb

Section 2 Operation and maintenance

2.1 Verify operation

⚠WARNING

FDOM sensors use an ultraviolet LED light source. Do not look directly at a UV LED when it is on. It can damage the eyes. Keep products that have UV LEDs away from children, pets, and other living organisms. Wear polycarbonate UV-resistant safety glasses to protect the eyes when a UV LED is on.

⚠CAUTION

Do not supply more than 15 VDC to the sensor. More than 15 VDC will cause damage.

Make sure that the sensor operates before further setup and deployment.

1. Connect the sensor to a PC that has a terminal program such as Tera Term or HyperTerminal® installed. Refer to Get and install terminal program on page 7 for instructions to get, install, and use a terminal program.
2. Remove the cap that protects the sensor's optical face.
3. Connect the sensor to a regulated power supply set at 12 VDC.
4. Turn on the power supply.
   The sensor comes on.
5. Start the terminal program on the PC.
6. Select the appropriate "COM Port" in the terminal program.
7. Select the correct serial port settings in the terminal program.
   - baud rate: 19200
   - stop bits: 1
   - data bits: 8
   - flow control: none
   - parity: none.

   Data shows in the terminal window.
8. Look at the data. The order of the data in counts, by column:
   - column 1: serial number of the sensor
   - column 2: chlorophyll LED forward voltage
   - column 3: chlorophyll low gain stage
   - column 4: chlorophyll high gain stage
   - column 5: chlorophyll reported
   - column 6: bb LED forward voltage
   - column 7: bb low gain stage
   - column 8: bb high gain stage
   - column 9: bb reported
   - column 10: FDOM LED #1 forward voltage
   - column 11: FDOM LED #2 forward voltage
   - column 12: FDOM low gain stage
   - column 13: FDOM high gain stage
   - column 14: FDOM reported

SeaOWLUVA-002	2857	50	49	49	3454	50	49	49	4298	4298	50	50	50
SeaOWLUVA-002	2849	50	51	51	3452	50	48	48	4296	4296	50	44	44
SeaOWLUVA-002	2849	50	51	51	3448	50	46	46	4297	4297	50	46	46
SeaOWLUVA-002	2845	50	49	49	3447	50	46	46	4294	4294	50	50	50
SeaOWLUVA-002	2846	50	50	50	3444	50	49	49	4291	4291	50	48	48
SeaOWLUVA-002	2842	50	50	50	3444	50	45	45	4291	4291	50	47	47
SeaOWLUVA-002	2841	50	46	46	3441	50	48	48	4291	4291	50	48	48
SeaOWLUVA-002	2839	50	47	47	3441	50	47	47	4288	4288	50	46	46
SeaOWLUVA-002	2840	50	50	50	3438	50	45	45	4289	4289	50	54	54
SeaOWLUVA-002	2839	50	50	50	3439	50	47	47	4285	4285	50	49	49
SeaOWLUVA-002	2838	50	50	50	3437	50	46	46	4286	4286	50	50	50

9. To stop the data, select **File**, then *Disconnect* (Tera Term).
   The data stops.
10. To close the program, select **File**, then *Exit*.

2.2 Set up for deployment

1. Refer to the previous section to make sure that the sensor operates correctly.
2. If necessary, remove the protective cap from the sensor.
3. Use an external power supply to supply power to the sensor for deployment.

Section 3 Reference

3.1 Delivered items

- the sensor
- a lock collar (not applicable for SLC)
- a plastic protective cover for the optical face
- the CD, with:
  - this user manual
  - the characterization/calibration page for the sensor.

3.2 Calibration

The manufacturer calibrates all scattering sensors to make sure that the data that is collected meets the sensor's specifications. This information is on the sensor-specific calibration page that comes with the sensor.

3.3 Characterization

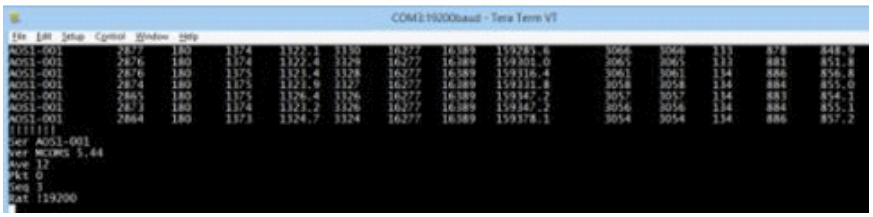
The manufacturer uses a fluorescent material to characterize all fluorescence sensors to make sure that the data that is collected meets the specifications of the sensor. This information is on the sensor-specific characterization page that comes with the sensor.

3.4 Get and install terminal program

Get and install a terminal communications program to communicate between the PC and the sensor. The steps below refer to Tera Term, an open-source terminal emulator program, but the set up and protocols are similar for other terminal communications programs.

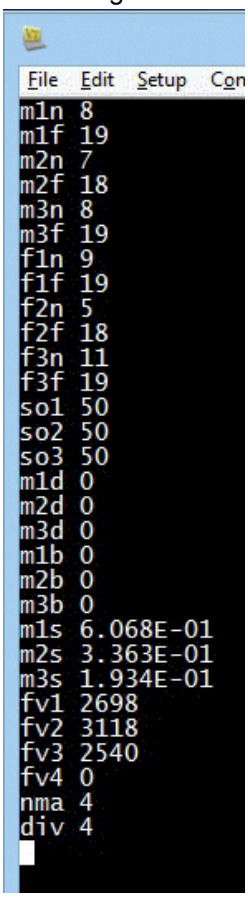
1. Do the steps on the web site www.ayera.com/teraterm/download.cfm to get the software.
   a. Enter the required information on the web site.
   b. Select "Save As" to save the software to a user-selected location on the PC.
   c. Right-click on the .zip file and select "Extract all..."
2. Go to the extracted files and double-click on the ttermpro.exe file.
3. Push **Run**.
4. Push **OK** in the **Tera Term: New connection** window.
5. In the **Tera Term Web 3.1 - COMx VT** window, go to **Setup**, then *Serial port...*
   - Port: user-selected COM x
   - Baud rate: 19200
   - Data: 8 bit
   - Parity: none
   - Stop: 1 bit
   - Flow control: none
   - Transmit delay, msec/char: 2
   - Transmit delay, 50 msec/line
6. Push **OK**.
7. To view commands as they are entered, go to the **Setup** menu, then *Terminal...* and put a check in the box next to "Local echo."
8. To save this setup, go to the **Setup** menu, then *Save setup...*.

9. Enter a new "File name," or push **Save** to save the default "teraterm.ini" setup file name.
10. Connect the sensor to a power supply set at 12 VDC and PC.
    Refer to Verify operation on page 5 for details.
11. Make sure that the terminal program is open.
12. Turn the power supply on.
13. Enter 5 exclamation points (! ! ! ! !) to put the sensor in an operational mode.
    The software shows 14 columns of data.
14. Enter ! ! ! ! ! to stop the sensor.
    The menu of the sensor shows below the collected data.



- ser: serial number of the sensor
- ver: version of installed firmware
- ave: the number of measurements that are averaged to make up one row of data.
- seq: the manufacturer-set sequence in which data is output.
- rat: baud rate

15. Enter **$par** to see the settings that are saved in the sensor.

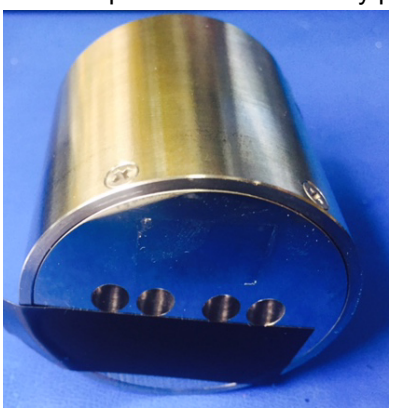


16. Enter **$run** to start the sensor.
    The sensor collects and shows data.
17. Find the offset, or dark counts value of the sensor for data correction.

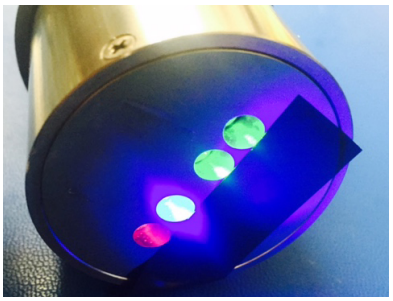
3.4.1 Find sensor offset value

Use the power supply that the sensor will use for deployment to find the offset value of the sensor output. It is possible that the offset given by the manufacturer is different because the sensor is very sensitive in terms of both input and output.

1. Cover the detectors on the optical face of the sensor with Scotch 33™ electrical tape. Make sure that the tape does not cover any part of the LED optical bore holes.



2. If necessary, connect the sensor to the PC and power supply and start the terminal program.
3. Turn the power supply on.
4. Enter **$run**, then push **Enter** to start the sensor operation. Let the sensor operate for approximately 60 seconds.



5. Enter **! ! ! ! !** to stop the sensor.
6. Calculate the average each of column 4, 8, then 13.
   These averages are the offset ("dark counts") values to use for chlorophyll, scattering, and FDOM.
7. Save these values to use when the data from a deployment is processed.
8. Remove the electrical tape from the optical face of the sensor.
9. Use a lint-free wipe and isopropyl alcohol to gently clean any remaining adhesive from the optical face.
   The sensor is ready to deploy.

3.4.2 Common terminal program commands

Command	Parameters	Description
!!!!!	none	Stops the data collected by the sensor. Lets the user to enter setup values. If the sensor is in a low-power mode, turn the power supply off for one minute, then turn the power on and push the "!" key 5 or more times.
$ave	1–255	The number of measurements that make up each row of collected data.
$mnu	—	Prints the menu of setup values to the PC screen.
$pkt	0–65535	Sets the number of rows of data that are collected between the specified time intervals.

Command	Parameters	Description
$rls	none	Gets the settings from the flash memory.
$run	—	Uses the current setup values to operate.
$sto	—	Saves the desired setup values to the flash memory.

Single-parameter sensors—Fluorometer and NTU only		
$asv	1 2 4	Sets the sensor's analog scaling value. 1 = the analog data collected covers the bottom quarter of the data range. 2 = the analog data collected covers half of the data range. 4 = the analog data collected covers the entire data range.

$m1d	0 to 65535	Parameter 1, dark count value to calculate the data collected in engineering units.
$m1s	float	Parameter 1, slope value to calculate the data collected in engineering units.
$m2d	0 to 65535	Parameter 2, dark count value to calculate the data collected in engineering units.
$m2s	float	Parameter 2, slope value to calculate the data collected in engineering units.
$m3d	0 to 65535	Parameter 3, dark count value to calculate the data collected in engineering units.
$m3s	float	Parameter 3, slope value to calculate the data collected in engineering units.
$man	1 = enable 0 = disable	Enables or disables manual start time. The sensor starts at a programmed wake time when enabled. This is automatically enabled if the user enters a manual start time.
$mst	24-hour time	Enables or disables a pre-programmed start time. This allows all sensors on a system to be synchronized to collect data.
$met	—	Prints metadata that describes the data that is collected. Field 1 is the data. Field 2 is the field tag. Field 3 is the field name. Field 4 is used for units where appropriate.
$rat	2400 to 230400	Baud rate for communication. An invalid baud rate will default to 19200. It will show as 19201 so the user knows the software defaulted to this value.
$rfd	—	Loads the original manufacturer's setup.
$seq	0 to 3	Selects one of the pre-defined sequences to use to collect data.

$osd	0–3	Shows the output sequence for the selected value. These values agree with the meta data shown with $mdl.
$ose	0–3	Starts the output sequence entry mode for the selected value. Enter data by line number: $nn<space>value<enter> *where* **nn** is the field number and **value** is the related output field that shows in that field. Start the sequence input with the delimiter $00 and end it with $99.
$par	—	Shows the timing and conversion parameters.

3.5 Set up variable output

The user can make and store up to four different custom output strings in the sensor. The definition of each output string is stored as a sequence from 0–3. The default from the manufacturer is sequence 3. The manufacturer recommends that the user does not change this sequence. The user can change the output string from sequences 0–2.

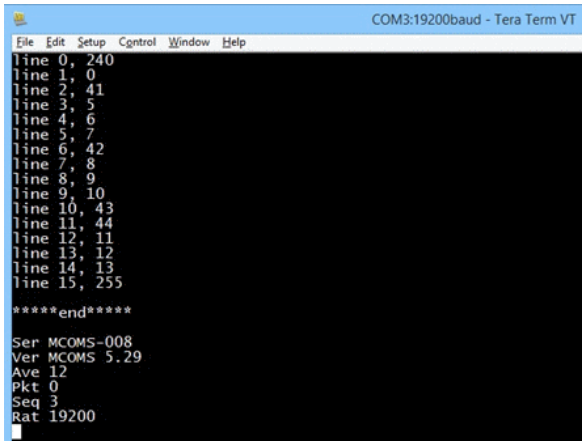
NOTICE

If the user changes the output string it is not possible for the manufacturer to make an analysis of sensor performance and the data that is collected by the sensor.

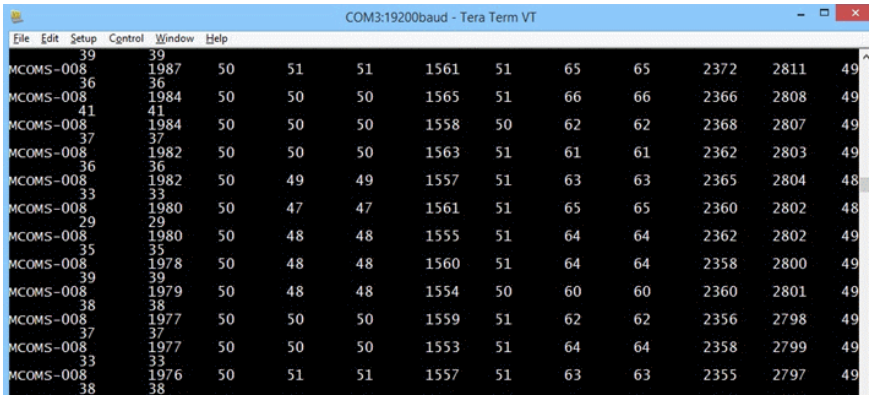
Table 1 Variable output fields

Value	Output
0	serial number
1	date, MM/DD/YY
2	time, HH:MM:SS
3	dummy date, 99/99/99
4	dummy time, 99:99:99
5	reference value 1
6	measurement 1 raw counts
7	measurement 1 engineering output 1.3E
8	reference value 2
9	measurement 2 raw counts
10	measurement 2 engineering output 1.3E
11	reference value 3
12	measurement 3 raw counts
13	measurement 3 engineering output 1.3E
14	internal thermistor counts
15	external thermistor counts
16	pressure sensor counts
17	supply voltage 2.2f
18	numeric part of serial number
19	cSlope1 1.3E, slope for engineering calculation
20	cSlope2 1.3E, slope for engineering calculation
21	cSlope3 1.3E, slope for engineering calculation
22	cleanValue1, dark counts for engineering calculation
23	cleanValue2, dark counts for engineering calculation
24	cleanValue3, dark counts for engineering calculation
41	forward voltage counts for channel 1 LED
42	forward voltage counts for channel 2 LED
43	forward voltage counts for channel 3 LED #1
44	forward voltage counts for channel 3 LED #2
240	printf tab
241	putchar 0x09 (tab)
255	printf/n (carriage return line feed)

Manufacturer-set Sequence 3



Manufacturer-set Sequence 3 output format



The output columns in the image above are wrapped if there is not sufficient space on a PC screen.

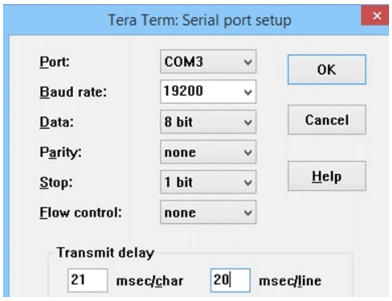
1. Start a spreadsheet program such as Microsoft Excel®.
2. Make a spreadsheet as in the example below.

	A	B
1	$ose	1
2	$0	240
3	$1	1
4	$2	2
5	$3	5
6	$4	6
7	$5	8
8	$6	9
9	$7	11
10	$8	12
11	$9	14
12	$10	255
13	$99	
14	$osd	

$0se	1	sequence number (**must come first**)
$0	240	start print (**must follow $ose)**)
$1	1	column 1 output = date (first column of output)
$2	2	column 2 output = time
$3	5	column 3 output = reference counts for channel 1
$4	6	column 4 output = measured raw counts for channel 1
$5	8	column 5 output = reference counts for channel 2
$6	9	column 6 output = measured raw counts for channel 2
$7	11	column 7 output = reference counts for channel 3
$8	12	column 8 output = measured raw counts for channel 3
$9	14	column 9 output = counts for the internal thermistor
$10	255	end print (required value)
$99		end sequence input (**must follow "end print"**)
$osd		display (show) the sequence (**must follow $99**)

3. Make sure that the sensor is on and in communication with the terminal program.

4. If necessary, start the terminal program.
5. Enter the values to set up the serial port:



6. Push **OK**.
7. Select the sequence made in Excel and copy (Ctrl-C) it.
8. Make sure that the cursor is in the terminal program and that the sensor is not in operation. and
9. Select *Paste* from the **Edit** menu.
10. Type **$sto** to store the new sequence in the sensor.
11. Type **$seq 1** to change the output of the sensor to the new sequence.
12. type **$run** to see the output format of the data that is collected by the sensor.

Section 4 General information

Revised editions of this user manual are on the manufacturer's website.

4.1 Warranty

This sensor is warranted against defects in materials and workmanship for one year from the date of purchase. The warranty is void if the manufacturer finds the sensor was abused or neglected beyond the normal wear and tear of deployment.

4.2 Service and support

The manufacturer recommends that sensors be sent back to the factory annually to be cleaned, calibrated, and for standard maintenance.
Refer to the website for FAQs and technical notes, or contact the manufacturer for support at:

support@wetlabs.com

Do the steps below to send a sensor back to the manufacturer.

1. Contact the manufacturer for a Return Merchandise Authorization (RMA).
   Note: *The manufacturer is not responsible for damage to the sensor during return shipment.*
2. Remove all anti-fouling treatment from the sensor before sending it back to the manufacturer.
   Note: *The manufacturer will not accept sensors that have been treated with anti-fouling compounds for service or repair. This includes tri-butyl tin, marine anti-fouling paint, ablative coatings, etc.*
3. Use the sensor's original ruggedized shipping case to send the sensor back to the manufacturer.
4. Write the RMA number on the outside of the shipping case and on the packing list.
5. Use 3rd-day air to ship the sensor back to the manufacturer. Do not use ground shipping.
6. The manufacturer will supply all replacement parts and labor and pay to send the sensor back to the user via 3rd-day air shipping.

4.3 Waste electrical and electronic equipment

Electrical equipment that is marked with this symbol may not be disposed of in European public disposal systems. In conformity with EU Directive 2002/96/EC, European electrical equipment users must return old or end-of-life equipment to the manufacturer for disposal at no charge to the user. To recycle, please contact the manufacturer for instructions on how to return end-of-life equipment, manufacturer-supplied electrical accessories, and auxiliary items for proper disposal.

4.4 Tera Term BSD license

Tera Term is used under a BSD open source license.

Copyright

```
This program is free software. Tera Term is licensed under BSD style license.

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inability to use the program (including but not limited to loss of data or data being rendered
inaccurate or losses sustained by you or third parties or a failure of the program to operate
with any other programs).

URL: http://ttssh2.osdn.jp/
Project: http://osdn.jp/projects/ttssh2/
e-mail: yutakakn@gmail.com (Yutaka Hirata)
forum: http://www.logmett.com/forum/index.php
ML(Japanese): http://www.freeml.com/info/teraterm@freeml.com

Tera Term Pro(original): http://hp.vector.co.jp/authors/VA002416/
ANSI color change & concatenating multi-line patch: http://www.sakurachan.org/ml/teraterm/msg00264.html
IPv6 version Tera Term Pro: http://win6.jp/TeraTerm/index.html
Eterm lookfeel transparency window patch: http://www.geocities.co.jp/SiliconValley-PaloAlto/4954/av.html
Oniguruma: http://www.geocities.jp/kosako3/oniguruma/

Special thanks to ...
- T.Teranishi - author of original Tera Term Pro
  URL: http://hp.vector.co.jp/authors/VA002416/
- Yutaka Hirata - added UTF-8 and SSH2 support
  e-mail: yutakakn@gmail.com
  URL: http://hp.vector.co.jp/authors/VA013320/
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